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NON-PROVISIONAL APPLICATION FOR UNITED STATES LETTERS PATENT

for

A REINFORCED SHUTTER

by

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FIELD OF THE INVENTION

[0001] The present invention relates to shutters and in particular to shutters of the roller type having improved resistance to storms and break-ins. It furthermore relates to a device for securing such shutters against storm damage.

DESCRIPTION OF RELATED ART

[0002] Shutters or blinds for windows, doors and other apertures are generally known. A common design for such shutters is the so-called roller shutter. Such roller shutters generally comprise a number of horizontally extending slats, articulated to one another to form a curtain. The curtain may be provided with a roller, usually located at the upper edge of the window, around which the curtain may be wound to raise it or lower it. The lateral edges of the curtain will usually be guided by vertically extending guides attached to the lateral edges of the window aperture. Guiding may be achieved by lateral extremities of some or all of the slats extending into a U-shaped channel within the guide. Other similar arrangements to provide effective guiding are also known.

[0003]Simple guiding arrangements may suffice for internal blinds or shutters for the purpose of preventing light, or for light-duty external shutters. For shutters intended to be resistant against strong winds, break-ins or other damage, further measures are required.

[0004] It is also known to provide shutters with additional security means in the form of storm bars, which can be applied vertically across either or both faces of the shutter to provide additional support. Such storm bars are both unsightly and inconvenient and require substantial space. Often, due to the size of the storm bar, the frame of the aperture must be further built out to provide sufficient clearance. Furthermore, since they are often only applied in readiness for a storm or when "shutting up at night", they may sometimes be absent when required, e.g. in the event of an unexpected storm. Likewise, conventional storm shutters lack a horizontal element other than the retracted, coiled shutter, and for use of conventional storm shutters, vertical supports must further be installed, often at great difficulty and requirement of extensive hardware. The vertical

supports commonly used in connection with a conventional storm shutter may require significant building out of the frame of the aperture or even beyond the frame of the aperture.

[0005]Arrangements have been suggested for increasing the storm resistance of shutters by providing wind-lock elements at the ends of some or all of the slats. The wind-locks may be in the form of T-shaped elements or other protuberances, which locate in C-shaped channels in the lateral guides. In order for sliding of the slats within the lateral guides to take place without jamming, there must be clearance between the wind-lock elements and the guides. Under storm conditions, this clearance allows the slat to bow inwards and outwards before it is restrained by the wind-locks. Such bowing is both undesirable and unacceptable, as it may result in breakage of the window or door the shutter was installed to protect. A device of this nature is known from United States Patent No 5,839,493 to Quasius.

SUMMARY OF THE INVENTION

[0006]According to the present invention, resistance to high winds and other forces may be achieved without the above-mentioned disadvantages by the use of a high-strength wire or cable tensioned across the building aperture to provide support to the shutter. There is thus provided a shutter for a building aperture comprising a shutter curtain having a first and a second face, the shutter curtain being locatable in the aperture, a filament spanning the aperture and lying in a plane substantially parallel and adjacent to the first face of the shutter curtain and a tensioning device for applying tension to the filament to provide support to the curtain against flexure thereof.

[0007]Advantageously the filament comprises a metallic wire of high modulus of elasticity, in particular a stainless steel or high strength alloy wire. Alternatively, the filament may comprise a high strength fiber cable of low extensibility such as the carbon fiber cords used in the rigging of sailing boats. In addition, the filament may be any

flexible strengthening means comprising a wire, cable, chain, or elongated support having sufficient flexibility to be wound around the tensioning device.

[0008]To ensure easy deployment and tensioning of the filament, the tensioning device may comprise a winch. The winch may comprise a locking element such as a ratchet, for selectively locking the winch against unwinding. Alternatively, the tensioning device may be a lever or cam element which tensions and locks the filament by pivoting about a fixed point. As a further alternative, the shutter curtain may itself provide tensioning of the filament as the shutter curtain is flexed or bowed by the pressure or vacuum forces induced by high winds. The shutter curtain may act as the tensioning device either alone or in combination with an additional tensioning device as above described.
[0009]The shutter may be of a generally standard form comprising first and second guides or sidetracks which respectively receive and guide opposing lateral edges of the curtain, the guides being located on opposing lateral edges of the aperture. A first end of the filament may then be retained on the first guide and a second end of the filament retained by the tensioning device provided on the second guide. Alternatively, a retaining element such as a hook or loop may be provided on the second guide with the filament passing around the retaining element and being received by the tensioning device attached to the first guide.

[0010]In order to provide further support to the shutter curtain, according to a further aspect of the invention a plurality of retaining elements may be provided in a distributed fashion over the length of both guides and the filament may be laced around the retaining elements such that it crosses the shutter curtain a number of times. For such an arrangement, the tensioning device must be capable of removing a greater amount of slack than is the case with a shorter filament which crosses the shutter a single time.

[0011]Where a plurality of retaining elements is provided, these may be either fixed or slidably mounted to the first and second guides. Alternatively, they may be mounted to the structure surrounding the aperture either directly or indirectly.

[0012]In a further alternative embodiment of the present invention a second filament may be provided to support the shutter curtain. The second filament may be provided with a second separate tensioning device or both filaments may be tensioned in parallel using the same device. In order to provide support against forces applied to both faces of the shutter (or acting in both directions), if the first filament is located adjacent to a first face of the shutter curtain, the second filament may be located in a plane substantially parallel and adjacent to the second face of the shutter curtain. Alternatively or additionally, further filaments may be provided adjacent to the same face of the shutter.

[0013]According to a desirable embodiment of the invention, a storage device may be provided for conveniently storing at least part of the filament when not under tension. Such a storage device may be a reel or may be provided by a cavity within the guides. The storage device may comprise an elastic element biasing the filament in a direction into the storage device.

[0014]According to a further aspect of the present invention, and particularly for use in conjunction with existing shutters, there is provided a storm retainer for retaining a shutter curtain against flexure, the shutter curtain being located across an aperture, the storm retainer comprising a filament; an anchor attached to a first portion of the filament and securing the first portion with respect to the aperture; and a tensioning device, the tensioning device being secured with respect to the aperture and being attached to a second portion of the filament wherein actuation of the tensioning device causes tensioning of the filament from the first portion to the second portion.

[0015]In a particularly advantageous embodiment of the present invention, there is provided a shutter for a building aperture comprising a plurality of slats articulated to one another to form a shutter curtain, at least one of the slats having a hollow interior. Lateral guides are located on opposite sides of the building aperture, each lateral guide having a channel serving to guide the curtain for sliding motion along the guides. A filament extends through the hollow interior of the at least one slat, the filament having first and second ends and a wind-lock is attached to each of the first and second ends of the

filament, extending into the channels of the guides. Restraining elements are located within the guides, the restraining elements preventing removal of the wind-locks from the channels. In order to tension the wind-locks against the restraining elements a tensioning device is provided for selectively applying tension to the filament. Such a device does not require separate storage of the tensioning filament since it remains effectively out of sight within the slat. Nevertheless, by providing for selective tensioning of the filament to lock the wind-lock within the guides, these can be subsequently released to allow for rolling up of the shutter curtain without snagging and jamming of the wind-locks. Various tensioning devices may be used to provide such selective tensioning.

[0016]The filament may comprise two filament sections joined by a turnbuckle, rotatable to draw the two filament sections together. Alternatively, a pivotable lever clamp may be provided to draw the two filament sections together.

[0017]In addition to the use of a shutter curtain having slats, it is also within the scope of this invention to employ a rigid panel supported by a filament as a covering to a building aperture. In the use of a rigid panel, such as one made of plywood, acrylic, polycarbonate, or thin metal, the filament may be laced through various apertures in the panel at a favorable orientation. In the alternate, the filament and panel could be bolted or otherwise together affixed to the building. The panel may have a plurality of holes around its perimeter so that a user may affix the panel to the building aperture wherever an opportunity exists to do so, without the need to drill more holes. A particularly useful filament for this embodiment of the invention is the Stake Eye cable, commercially produced by Loos & Co., available in a variety of sizes according to the user's need. One advantage of using a filament to support a rigid panel would be that the additional support provided by the filament could allow use of a thinner rigid panel or a less corrugated rigid panel than would be required without the use of a filament. A decrease in panel thickness or corrugation would make the panels lighter in weight. When panels are made of translucent or transparent materials, a decrease in thickness or corrugation would improve visibility through the panel and also would allow more light to penetrate the building than with a thicker material.

[0018]The invention also provides for a method of restraining a shutter provided in a building aperture against flexure, the method comprising providing a substantially inextensible filament, disposing the filament across the aperture to lie substantially in the plane of the shutter and applying tension to the filament.

DESCRIPTION OF THE FIGURES

[0019]Embodiments of the invention will now be explained in further detail by way of example only with reference to the accompanying figures, in which:

[0020]Figure 1 is an elevation of a window aperture including a storm retainer according to a first embodiment of the invention;

[0021]Figure 2 is an elevation of a window aperture including a storm retainer according to a second embodiment of the invention;

[0022]Figure 3 is a partial horizontal sectional view of a third embodiment of a storm retainer according to the present invention;

[0023]Figure 4 is a partial view of a retaining arrangement for the device according to Figure 3, taken in the direction B-B;

[0024]Figure 5 is a detailed view of the tensioning device of Figure 3;

[0025]Figure 5B is a detailed view of an alternative tensioning device to that of Figure 5;

[0026]Figure 6 is a partial horizontal sectional view of a fourth embodiment of the present invention;

[0027]Figure 7 is a side cross-sectional view through a shutter assembly according to the present invention;

[0028]Figure 8 is a side cross-sectional view through an alternative shutter assembly to that of Figure 7;

[0029] Figure 9 is a detail cross-sectional view along direction C-C of Figure 8;

[0030]Figure 10 is an elevation of a window aperture including a storm retainer according to a fifth embodiment of the invention;

[0031]Figure 11 is a side view of a sixth embodiment of the present invention;

[0032]Figure 12 is a partial horizontal sectional view of an alternative shutter assembly to that of Figure 6;

[0033]Figure 13 is an elevation of a window aperture including a storm retainer according to an alternative to the embodiment of Figure 1;

[0034] Figures 13a and 13b depict a horizontal sectional view of the embodiment of Figure 13 under conditions free from wind pressure and conditions of wind pressure, respectively; and

[0035] Figure 14 depicts an elevation of a seventh embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0036]Figure 1 illustrates a first embodiment of the present invention, applied to a window aperture 1. For the sake of clarity, details of the window itself are not shown. In the following description, reference will be made interchangeably to window and aperture. Although reference is made to a window, this is also intended to include doors, roof lights, French windows and any other openings in a building or structure for which it may be desirable to provide additional storm security.

[0037]Aperture 1 is provided with a pair of guides 3,4 located on opposite lateral edges of the aperture 1. Guides 3,4 serve to guide motion of a shutter curtain 10, which may be raised or lowered by a suitable mechanism (not shown) to selectively cover the aperture 1. The shutter curtain 10 may be a roller shutter of otherwise standard configuration formed of a plurality of slats 12 articulated together, whereby the curtain may be rolled up within a shutter casing 14.

[0038]According to a first aspect of the present invention, an anchor 20 is attached securely to guide 4 adjacent to an upper left-hand corner of the aperture 1. A filament 22 is attached to the anchor 20 and crosses the aperture 1 diagonally to a second anchor 24 located adjacent to the lower right-hand corner of the aperture 1. The second anchor 24 is located on a lever 26 pivoted to the guide 3 at a pivot point 28. By clockwise rotation of the lever 26 in the direction of the arrow A, the filament 22 may be tensioned. A locking pin 30 is provided for insertion into a suitable hole in the guide 3 to maintain the lever 26 in the tensioned position.

[0039]By appropriate tensioning of the filament 22 between anchors 20 and 24, a lateral deflection of the mid-point of the filament 22 may be reduced to an amount dependent upon the modulus of elasticity of the filament 22 and the lateral force applied. Use of filaments made from high-modulus materials such as steel wire, in particular stainless steel or carbon-fiber cord has been found to be particularly advantageous. Other materials having similar properties of flexibility, strength and lightness may also be considered.

[0040]In contrast to prior art systems which require sturdy metal bars to be placed across the shutters to provide support, the device according to the present invention is extremely lightweight and can be easily deployed and conveniently stored when not required. The anchor 20, which may also be in the form of a hole or slot directly in the guide 4 itself, can be left in place, while filament 22 and lever 26 can be removed for storage. Conveniently, the lever may be arranged so that the filament can be wound around it for storage. Pivot point 28 and locking pin 30 may be removed or left in place as desired.

Alternative storage possibilities for the filament 22 may also be provided, thus the filament 22 may be concealed within a hollow internal channel within the guide 4 and extended to a fixed stop only when needed. Elastic retraction means such as a spring or elastic cable could be provided within such a channel to facilitate retraction of the filament when not in use.

[0041]Once the filament 22 is tensioned across aperture 1, forces on the shutter curtain 10 tending to push it against the filament 22 will be resisted by the elastic deformation of the filament 22 as well as by the support provided around the periphery of the curtain 10 by the guides 3,4. In an alternative to the use of a tensioning device, Figure 13 depicts the shutter curtain 10 in combination with guides 3 and 4, anchors 20 and 20', and filament 22. Not shown is an optional second filament 22' located on the opposite side of the shutter curtain. Tensioning of filaments 22 and 22' across aperture 1 may occur even without the use of a tensioning device, through the pressure and vacuum forces of high winds, as depicted in Figures 13a and 13b.

[0042]The shutter curtain 10 may optionally be provided with a hook element 32 through which filament 22 may be threaded or looped. Hook element 32 is preferably recessed into one of the slats 12 forming the curtain 10 to prevent it from interfering with the rolling up of the curtain 10. By passing the filament 22 through the hook element 32, the filament 22 may also serve to resist forces on the shutter curtain 10 in a direction tending to push it away from the filament 22. This is particularly important since storm shutters must be capable of resisting both pressure and vacuum forces induced by high winds.

[0043]It will be evident to the skilled man that alternative forms of hook element 32 may be provided and that, instead of a single element, numerous such elements could be provided along the course of the filament 22. Alternatively or additionally, a second filament together with appropriate anchoring and tensioning devices may be provided on the other face of the shutter curtain 10, whereby the shutter curtain is effectively sandwiched between two tensioned filaments, as depicted in Figure 11.

[0044]Figure 2 discloses a second embodiment of the present invention in which like numerals are used to denote the same elements as in Figure 1. According to Figure 2, aperture 1 is provided with a shutter casing 14 into which the shutter curtain 10 has been retracted. In this embodiment, in order to provide greater support for the curtain 10, guides 3, 4 are provided with a number of retainers 34 distributed between them. Filament 22 is attached to anchor point 20 at the upper left-hand corner of the window and passes in turn around the retainers 34 in a zigzag manner. To aid in the attachment of the filament 22 around the retainers 34, the retainers 34 are open on one side (not shown) in the form of a hook. In this way, the filament may be looped around them in the manner of lacing up mountaineering boots. As an alternative to such hooks, retaining loops or eyes could be used whereby the filament would be threaded sequentially through each loop or eye. At the lower right-hand corner of the aperture 1, a winch 36 is provided. Winch 36 is a conventional ratchet operated device around which the filament 22 may be wound. Suitable connection means (not shown) are provided at the free end of the cable to assist connection to the winch 36. Actuation of the winch 36 causes the filament 22 to be tensioned and the ratchet mechanism allows it to be locked in place. The tensioned filament 22 serves to support the shutter curtain in substantially the same way as in the embodiment of Figure 1.

[0045]Advantageously, the winch 36 may serve to wind up the filament 22 when not in use and may then be removed for storage. In order to ensure equal tension along the length of the filament 22, bearings (not shown) may be provided to reduce frictional forces between the filament 22 and the retainers 34. The bearings may be in the form of a lubricated surface such as PTFE on either the filament 22 or the retainers 34 or both. Alternatively, the retainers 34 may be provided with roller or pulley-type elements over which the filament 22 is passed. As in the case of Figure 1, a second filament and tensioning arrangement may be provided for the other face of the shutter.

[0046]Other methods of storing and deploying the cable may also be used. While the retainers 34 of Figure 2 are shown in fixed locations, they may also be arranged to slide in grooves formed in the guides 3,4. When not in use, the retainers 34 and filament 22

may be slid upwards for storage at the upper edge of the aperture, any resulting slack in the filament 22 being taken up by an appropriate retraction mechanism as described above.

[0047]In the embodiments of both Figure 1 and Figure 2, the anchor 20 and the tensioning device (lever 26 or ratchet 36) have been located on the guides 3, 4. According to the present invention, these elements as well as the retainers 34 of Figure 2 may also be located independently of the guides, either affixed directly to the structure forming the aperture or forming part of a separate element to be located adjacent to the guides 3,4. Such a configuration may be beneficial in situations where it is desired to retro-fit storm protection according to the present invention to existing shutters.

[0048]A further embodiment of the present invention is shown in Figures 3 to 5 in which once again like numerals are used to denote the same elements as in Figure 1. Figure 3 shows a partial horizontal sectional view through a shutter, showing generally C-shaped guides 3, 4. Guides 3, 4 are securely attached to the outside face of a wall 17 by suitable bolts 18 or other appropriate fastening means. The guide 4 includes front and rear profiles 38, 38' between which a slot 39 is provided in which the shutter curtain 10 may slide. Front and rear nuts 40, 40' are securely supported within the front and rear profiles 38, 38' respectively and attached to front and rear filaments 22, 22'. For this purpose, each filament 22, 22' is provided with a tensioning device in the form of a knob 42, 42' with threaded extension 44, 44'. The threaded extensions 44, 44' locate within threaded bores of nuts 40, 40'. At the other extremity of both filaments 22, 22', front and rear anchors 20, 20' are provided for retention by guide 3, as will be described below.

[0049]Figure 4 is a partial side view of a section of guide 4, taken in direction B-B of Figure 3. Figure 4 shows how nuts 40, 40' are retained within profiles 38, 38' by means of keyhole- shaped slots 46, 46'. As can be seen from the dotted profile of nuts 40, 40', the nuts 46, 46' are sized to fit through the larger portions 48, 48' of slots 46, 46' and to lock in the downwardly extending narrow sections 50, 50'. From Figure 4, it can also be

seen how the square-shaped head of the nut 40 (shown partially in broken lines) prevents the nut 40 from rotating within the profile 38 when the knob 42 is rotated.
Anchors 20, 20' are retained in a similar manner in similar slots provided in the guide 3. In this manner, filaments 22, 22' are easily removed, when desired, for storage

[0050]In use, when it is desired to secure the aperture against storm damage or break-in, a filament 22 is retrieved from storage and anchor 20 is located within the locating slot provided in guide 3. Then, the filament 22 is extended across the aperture and the nut 40 is located within slot 46 as described above. Knob 42 is then threaded inwardly to move threaded extension 44 into the nut 40 to cause the filament 22 to be tensioned. Because of the high modulus material used for the filament 22, the filament 22 is very inextensible and sufficient tension may be achieved with little relative movement between the threaded extension 44 and the nut 40. A similar procedure is then followed for filament 22'.

[0051]Figure 3 illustrates the position in which filament 22' has been tensioned by advancing threaded extension 44' through nut 40', while filament 22 is still relatively slack. The arrangement of the filaments may be conducted with the shutter curtain in the raised position. Once the filaments are in place and tightened, the shutter may be slid down along the slot 39 through the gap separating the filaments 22, 22'.

[0052]Figure 5 illustrates in further detail the construction of one of the tensioning arrangements of figure 3. In order to attach the filament 22 to the knob 42, the threaded extension 44 is provided with a hollow bore 52 through which the filament 22 extends. The extremity of the filament 22 carries a spherical terminus 54 having a diameter slightly larger than the inner diameter of bore 52. When tension is applied to the filament 22, terminus 54 seats against the end of threaded extension 44 but allows rotation between the two surfaces. In this way, twisting of the filament 22 on rotation of knob 42 is prevented.

[0053]An alternative arrangement for retaining and tensioning the ends of the filaments for the embodiment of Figure 3, is illustrated in Figure 5B. According to this embodiment, instead of the keyhole shaped slots 46, 46', the profile 38 is provided with a threaded nut or insert 45, securely attached by welding, adhesives or otherwise to the face of the profile 38. Figure 5B shows in detail the threaded extension 44, which in this construction requires no nut, since it can be screwed directly into the insert 45. It is to be noted in Figure 5B, that the spherical head 54 of the filament 22 must be smaller than that of the embodiment of Figure 5, to allow insertion into the insert 45.

[0054]Although a single pair of filaments 22, 22' has been illustrated in the above embodiments of Figures 3 to 5, it will be evident to the skilled man that further filaments may be provided at different positions over the height of the shutter. Similarly, although the illustrated embodiment is of horizontally disposed filaments, such filaments may also be arranged vertically between suitably located profiles along the upper and lower edges of the window aperture. The skilled man will also recognise further alternative ways of providing tension to the individual filaments. The tension may be provided by individual devices located either on the filament itself or on one or both of the guides. Alternatively, a single tensioning device may be used to tension all of the filaments (at least on one side of the shutter curtain) in parallel. As an example of such a system, it is envisioned that the profile 38 could be mounted for lateral movement with respect to e.g. the guide 4. Movement of the profile 38 in a direction away from the opposite guide 3 would serve to tension any filaments attached between profile 38 and the guide 3 and could be accomplished by appropriate screw or camming devices.

[0055]In the embodiments according to Figures 1 to 5, the filament 22 has been disposed in a position adjacent to an outer face of the shutter curtain. According to a further embodiment of the invention, the filament 22 may be located within one or more of the slats 12 forming the shutter curtain 10. Figure 6 illustrates a partial cross sectional view of such a device including guides 3, 4, shutter slat 12 located in slot 39 and filament 22. The slat 12 has a hollow interior 56 through which the filament 22 is threaded. Both extremities of the filament are provided with wind-locks 58 which prevent pullout of the

slat from the slot 39 by engagement with restraining elements in the form of internal ribs 60. In order to provide for tensioning of the filament 22, a turnbuckle 62 is provided at an intermediate point along the filament 22. The turnbuckle 62 may be of standard design and comprises left and right handed screw threads 64, 66 whereby rotation of the turnbuckle causes the two ends of the filament to be drawn together. The turnbuckle 62 may be located in a recess 68 in the slat 12, accessible only from the interior of the shutter, thereby enhancing security against break-ins. Other well-known devices for tensioning the filament 22 may be used instead of the turnbuckle 62. Such devices may include lever action tensioning buckles or the like. Alternatively, the tensioning arrangement may be arranged to act on the wind-lock 58 by e.g. movement of one or both of the guides 3,4 or by the provision of movable restraining elements instead of the fixed internal ribs 60 as depicted in Figure 12.

[0056]For the embodiment of Figure 3, where profiles are arranged on either side of a guiding slot, additional provisions may be required to ensure that the shutter operates correctly. Figure 7 is a side cross-sectional view through a shutter assembly mounted onto the external face of the wall 17 of a building showing the shutter curtain 10 wound up inside shutter casing 14. Figure 7 also shows profiles 38, 38' mounted on either side of slot 39 and a number of keyhole shaped slots 46, 46' for receiving the nut of a storm retainer filament (not shown). The presence of profile 38' means that the slot 39 is distanced from the wall 17 by a distance corresponding to the thickness of the profile 38'. In order to ensure that the shutter curtain 10 enters the slot 39 with minimum friction and without snagging, a roller 70 is located within the shutter casing 14 above the profile 38'.

[0057]Figure 8 illustrates an alternative arrangement to that of Figure 7, in which the shutter casing 14 is spaced from the wall 17 by a distance corresponding to the thickness of the profile 38'. In the illustrated embodiment, the profile 38', itself serves as the spacer, extending upwards beyond the upper edge of the other profile 38 and the slot 39. This is advantageously achieved by forming the guides 3, 4 as two-piece extrusions as shown in Figure 9. Figure 9, which represents a cross-section taken along line C-C in

Figure 8 shows how the first profile 38 together with slot 39 are formed as a first element, while the second profile 38' is separately formed as a second element.

[0058]Figure 10 discloses a fifth embodiment of the present invention in which like numerals are used to denote the same elements as in Figure 1. According to Figure 10, aperture 1 is provided with a pair of guides 3,4 located on opposite lateral edges of the aperture 1. The aperture is also provided with a shutter casing 14 within which the curtain has been retracted. Separate filaments 22, 22', and 22'' are attached at one end to anchors 20, 20', and 20'', respectively, which are themselves attached to guide 4. Filaments 22, 22', and 22'' are also attached at their other ends to anchors X, X', and X'', respectively, which are, in turn, attached to guide 3. Filaments Y and Y' are attached transverse to filaments 22, 22', and 22'' such that the entire assembly of filaments forms a grid. Although Figure 10 shows a grid assembly having three horizontal filaments and two vertical filaments, such an assembly could have varying numbers of horizontal and vertical filaments within the present disclosure.

[0059]For the above embodiments, the guides 3, 4 are preferably formed from metal or other high strength materials in order to withstand the forces applied to the shutter curtain 10 by high winds or during an attempted break-in. This is especially important in those cases where the anchors for the filament are provided on the guides themselves and tensioning takes place between the guides. Preferably, the guides are formed as extrusions of metal. High strength aluminium alloy has been found especially suited to this purpose.

[0060]In the embodiment depicted in Figure 14, rigid panel Z is depicted in a building aperture wherein filaments 22 and 22' are threaded through holes in the panel in a cross-wise configuration.

[0061]Many further modifications in addition to those described above may be made to the structures and techniques described herein without departing from the spirit and scope

of the invention. Accordingly, although specific embodiments have been described, these are examples only and are not limiting upon the scope of the invention.